

Comparison of Carrington's Circumpolar Catalogue with the Greenwich-Groombridge System. By W. G. Thackeray.

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The forthcoming Greenwich Catalogue for 1900 will consist of two parts : Part I., Fundamental and Zodiacal Stars ; Part II., Astrographic Reference Stars. This latter part consists of some 10,000 circumpolar stars within 26° of the pole. As the Carrington Catalogue affords the only data from which the proper motion of the majority of the stars within 9° of the pole can be determined, it is necessary to investigate its systematic errors, and for this purpose a comparison has been made with those stars which are common to it and the Groombridge-Greenwich system. There are ninety-four stars available, which have been grouped in degrees according to the Carrington Catalogue place.

The Carrington Catalogue contains 3735 stars, extending from 0° to 9° polar distance. The positions are based on instrumental errors derived from twenty special polars the places of which were finally determined by reference to double transits of *Polaris* and *Ursae Minoris* (Introduction, pp. 13, 22-35). Four or more of these stars—two above pole and two below pole whenever possible—were taken for the determination of the meridian error and of the polar point (p. 15). The circle, which was made to turn on its collar and which was divided by Troughton & Simms's well known engine, was not provided with any means for the determination of errors of division. As the circle was not moved by Carrington during the period covered by his catalogue observations the division errors are the same throughout and necessarily remain uncorrected (p. 16). There were four fixed microscopes with which to read the circle, a vertical and horizontal pair, but after the first year only the horizontal pair were used (p. 7). The catalogue stars were observed and arranged in three sub-zones.

The first sub-zone from $45'$ to 4° of N.P.D.

„ second „ „	$4^{\circ} 7'$	„
„ third „ „	$7^{\circ} 9'$	„

The places of the stars in the first sub-zone depend on practically an equal number of observations above and below pole. The stars in the second sub-zone for 4° to 6° are mostly observed for the first three hours either one above or two below, or two above and one below. For 7° , with few exceptions, and for the third sub-zone, stars are observed entirely above pole.

The results of the comparison taken as corrections to Carrington's Catalogue place given in the following tables are :—

	$0^\circ.$	$1^\circ.$	$2^\circ.$	$3^\circ.$	$4^\circ.$	$5^\circ.$	$6^\circ.$	$7^\circ.$	$8^\circ.$	$9^\circ.$
	s	s	s	s	s	s	s	s	s	s
R.A.	+0.0	-0.2	+0.7	-0.3	-0.4	-0.3	+0.2	-0.3	+0.4	-0.0
N.P.D.	-0.3	+0.3	+0.5	+0.6	+0.9	+1.0	+1.1	+1.2	+1.4	+0.1
No. of stars	1	7	4	11	10	15	11	11	7	7

It has been decided to apply a systematic correction of $-0^s.3$ to the right ascension of stars of 5° to 9° N.P.D. The corrections to the north polar distances which are regular and systematic seem to point to the influence of uncorrected division errors, and this is confirmed from further comparing the observations above with those below pole, which can be easily done from the ledgers in the sub-zones where the observations below the pole are marked with an asterisk (*) and the difference from the adopted catalogue place given for each observation.

The following is the excess of N.P.D. above pole :—

$0^\circ.$	$1^\circ.$	$2^\circ.$	$3^\circ.$	$4^\circ.$	$5^\circ.$	$6^\circ.$	$7^\circ.$
-0.1	-0.3	-0.4	-1.0	-1.0	-1.3	-1.4	-1.6
12	122	178	302	104	95	121	6

The stars at 4° are made up of thirty-nine stars in the first sub-zone and sixty-five in the second sub-zone.

The following are the systematic corrections to be adopted for the north polar distances.

For the second sub-zone in which the observations below pole are not symmetrical and are most numerous at $0^h - 3^h$, in order to obviate systematic differences it will be first necessary to bring into line the catalogue place of all stars which have S.P. observations by applying a correction to all S.P. observations as follows :—

N.P.D.	Correction.
4°	$-1^s.0$
5	$-1^s.3$
6, 7°	$-1^s.4$

Then, as the first sub-zone contains an equal number of observations above and below pole, and in the third sub-zone all the observations are above pole, the following are adopted as the corrections from the catalogue comparison :—

N.P.D.	Correction.	N.P.D.	Correction.
$0, 1^\circ$	$+0^s.3$	6°	$+1^s.1$
2	$+0^s.5$	7	$+1^s.2$
3	$+0^s.6$	8	$+1^s.2$
4	$+0^s.9$	9	$+1^s.2$
5	$+1^s.0$		

Comparison between Carrington and Groombridge-Greenwich in R.A. for each 1° of N.P.D.

$0^\circ.$	$1^\circ.$	$2^\circ.$	$3^\circ.$	$4^\circ.$	$5^\circ.$	$6^\circ.$	$7^\circ.$	$8^\circ.$	$9^\circ.$
0.7^*	0.2^*	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
0.3^*	0.6^*	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
0.1^*	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.2^*	0.0^*	0.3^*	0.6^*	0.9	1.2	1.5	1.8	2.1	2.4
0.7	\dots	0.5^*	0.8	1.0	1.2	1.4	1.6	1.8	2.0
0.6^*	\dots	0.4	0.8	1.0	1.2	1.4	1.6	1.8	2.0
1.5	\dots	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
\dots	\dots	0.1^*	0.6	1.1	1.6	2.1	2.6	3.1	3.6
\dots	\dots	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6
\dots	\dots	0.2^*	0.1^*	0.0^*	0.0	0.0	0.0	0.0	0.0
\dots	\dots	0.0^*	0.0	0.0	0.0	0.0	0.0	0.0	0.0
\dots	\dots	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
\dots	\dots	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Means $+0.4$	-0.3	$1.0 -$	$1.0 +$	$2.0 -$	$2.0 +$	$3.0 -$	$3.0 +$	$4.0 -$	$4.0 +$

Comparison between Carrington and Groombridge-Greenwich in N.P.D. for each 1° of N.P.D.

$0^\circ.$	$1^\circ.$	$2^\circ.$	$3^\circ.$	$4^\circ.$	$5^\circ.$	$6^\circ.$	$7^\circ.$	$8^\circ.$	$9^\circ.$
0.3^*	1.2^*	0.7	1.0	0.9	1.2	0.5	0.3	1.7	1.4
0.1^*	0.4^*	0.0	0.8	1.8	1.3	1.7	0.8	0.4	0.9
0.2^*	0.7	1.1	0.8^*	0.5	0.4	1.7	1.6	0.5	0.5
0.9^*	0.3^*	0.7^*	0.7^*	1.8	1.5	2.3	1.6	1.2	0.9
0.3	\dots	1.1^*	0.3	0.9	1.1	0.1	0.4	0.9	1.4
0.3^*	\dots	1.4	1.2	0.6	1.4	0.1	0.1	1.1	1.4
\dots	\dots	1.2	1.1	0.9	1.3	0.1	0.1	1.5	1.4
\dots	\dots	0.2^*	1.1	1.1	0.1	0.1	0.1	0.1	0.1
\dots	\dots	0.2	0.4	0.6	1.3	1.2	2.8	1.2	1.2
\dots	\dots	0.5^*	1.2	1.3	1.2	1.2	1.2	2.6	2.6
\dots	\dots	0.4^*	\dots	0.9	0.8	0.5	1.5	1.5	1.5
\dots	\dots	\dots	\dots	0.9	\dots	\dots	\dots	2.0	2.0
\dots	\dots	\dots	\dots	0.1	\dots	\dots	\dots	1.5	1.5
\dots	\dots	\dots	\dots	1.5	\dots	\dots	\dots	1.7	1.7
\dots	\dots	\dots	\dots	0.3	\dots	\dots	\dots	2.0	2.0
\dots	\dots	\dots	\dots	\dots	\dots	\dots	\dots	1.4	1.4
Means $+0.3$	$+0.5$	$+0.5$	$+0.6$	$+0.1$	$+0.1$	$+0.2$	$+0.4$	$+0.4$	$+0.1$

Reference Numbers from Carrington's and Groombridge's Catalogues of the Comparison Stars for each 1° of N.P.D.

	$0^{\circ}.$		$1^{\circ}.$		$2^{\circ}.$		$3^{\circ}.$		$4^{\circ}.$		$5^{\circ}.$		$6^{\circ}.$		$7^{\circ}.$		$8^{\circ}.$		$9^{\circ}.$		
	Carr.	Groomb.																			
1035*	1119	117*	144	140	175	145	195	52	67	451	595	1538	1633	593	774	76	100	346	506		
181*	235	956*	1141	236	339	131	177	1127	1359	2080	2063	1165	1391	1021	1255	429	580				
1834*	1884	1830	1871	491	642	575*	750	1516	1620	2105	2079	1222	1431	1045	1278	675	856				
1972*	2006	2316*	2283	842*	1004	770*	944	1746	1818	2222	2170	1807	1858	1301	1480	2348	2275				
2048	2065	...	...	1793*	1850	782	956	1790	1848	2261	2196	2360	2286	1381	1537	2350	2276				
3058*	3308	...	...	2122	2099	1205	1418	1818	1860	2404	2315	2550	2422	1558	1643	3140	3268				
3138	3402	...	...	2258	2210	2001	2007	1836	1879	2648	2476	3323	3597	1580	1662	3149	3276				
				2755*	2628	3441	3820	1843	1889	2729	2548	3387	3707	1698	1778						
				2771	2667	3444	3824	1847	1892	2820	2708	3389	3709	1707	1782						
				3273*	3548	3693	4193	1882	1923	2822	2712	3502	3928	1774	1842						
				3621*	4101	...	...	1913	1937	3525	3970	3681	4174	1784	1843						
						1914	1940	...	...	...	...	...	...	...	...	1868	1909				
						2271	2213	...	...	...	...	...	...	...	...	1889	1927				
						3091	3212	...	...	...	...	...	...	...	...	1968	1977				
						3123	3260	...	...	...	...	...	...	...	...	2083	2071				
																3133	3261				
																3189	3370				

An asterisk (*) denotes that the star was one of Carrington's special polars.

The Total Solar Eclipse of 1908 January 3.
By A. M. W. Downing, D.Sc., F.R.S.

There are two Pacific islands favourably placed for the observation of this eclipse, viz. Hull Island, one of the Phoenix group, and Flint Island, one of the Line group. The astronomical details of the eclipse for these two islands are given below, the calculations having been made from the data of the *Nautical Almanac*. As the errors of the Moon's tabular places now amount to sensible, and apparently increasing, quantities, observers are warned that the calculated times of the various phases of the eclipse may differ considerably from the observed times, the calculated times being (with the present values of the errors) too late. In order to obviate, as much as possible, inconvenience arising from this cause, I have added in each case the intervals in time from the instant when the cusps subtend an angle of certain specified value at the Sun's centre to the commencement of totality.

The plans of the islands here reproduced are taken from the official charts published by the Hydrographic Office. The geographical details are abridged from the *Admiralty Sailing Directions, Pacific Islands*, vols. ii. and iii., 3rd ed., 1900.

The offices of Levers' Pacific Plantations Company, mentioned below, are situated at Port Sunlight, Cheshire. Intending observers of the eclipse should communicate with the Company at this address.

My thanks are due to Capt. A. M. Field, R.N., F.R.S., for his kindness in referring me to the available sources of information regarding these islands.

HULL ISLAND. Long. $172^{\circ} 13'$ W. Lat. $4^{\circ} 30'$ S.

Mean Solar Time.

	Greenwich.	d h m s	Local.	Angle from					
				d	h	m	s	North Point.	Vertex.
First Contact.	... Jan. 3	7 18 33	Jan. 2	19	49	41		281°	5°
Total Eclipse	... {	3 8 30 36	2 21	1	44	35		88	162
		3 8 33 27						294	8
Last Contact	... ...	3 9 58 12	2 22	29	20			100	155

Duration of totality, 2m. 51s.

Sun's altitude at totality, 43° .

Angle of Cusps.	Time before Commencement of Totality. s
90°	34
60	13
45	7
30°	3
15	$\frac{3}{4}$